

**REMARKS**

Responsive to the Official Action dated May 12, 2003, applicants respectfully request reconsideration of the present application in view of the foregoing amendments to the claims.

As a threshold matter, the Examiner has rejected original claim 9 under Section 112, second paragraph, due to the possibility that the claim might be interpreted to encompass a zero value for the amount of yttria. The Examiner will note that applicant has amended claim 9 to recite "about 4 weight% Yttria," i.e., an amount fully consistent with the description of the invention in the specification at, for example, page 6, paragraph 11:

"Surprisingly, it has now been found that an improved thermal insulating ceramic layer in accordance with the invention can be formed of zirconia that has been partially stabilized by yttria in the amount substantially lower than predicted by Stecura, namely about 4 weight% (referred to herein as "4 YSZ"). For the first time, it has also been found that the yttria-stabilized zirconia can be applied using a dense vertically cracked ("DVC") vapor deposition process. Using the DVC process, the yttria transforms the ceramic into a tetragonal crystal structure that resists volume changes during repeated thermal cycling. The stabilized transformation also toughens the zirconia when mechanical stresses are applied. Preferably, the zirconia formed using the DVC process includes 0-1% Hafnia ( $\text{HfO}_2$ ) in solid solution."

Applicant has also cancelled dependent claim 11 in favor of new independent claim 13 in response to the Examiner's 112 indefiniteness rejection of claim 11. Claim 13 covers a thermal barrier coating having the same basic components as claim 1 (including about 4

weight% Yttria), but specifies that the bond coating results from a diffusion aluminide or platinum aluminide that forms an oxidation-resistant intermetallic. *See* page 9, paragraph 18 of the specification. In view of the above amendments, applicants submit that the Examiner's rejections based on Section 112 should now be withdrawn.

On page 2 of the Official Action, the Examiner rejected claim 9 under Section 102 based on Nissley et al, U.S. Patent No. 5,780,171. The Nissley et al patent describes a coating for gas turbine engine components containing vertical microcracks with a "base coat foundation layer" (*see* 18 in Fig. 2) containing between about 6 weight percent and about 20 weight percent yttria-stabilized zirconia, with a preferred range of between 7 and 12 weight %. *See* Col. 4, lines 21-22. Clearly, Nissley et al '171 does not teach or suggest using applicant's lower amount of yttria. For that reason alone, it does not anticipate amended claim 9 under Section 102.

In addition, Nissley et al '171 is no different from other teachings in the art against using low threshold amounts of yttria. Clearly, Nissley et al did not recognize that using amounts lower than 6% by weight would ever result in improved durability and erosion resistance of the final coating. Thus, a rejection under section 103 based on Nissley et al alone would be equally improper.

Applicants also submit that the teachings of Nissley et al '171 cannot realistically be combined with any other prior art of record under Section 103 because Nissley et al does not suggest to persons skilled in the art that lowering the amount of yttria would result in the improved physical properties achieved by applicants' invention.

As applicants noted in the Amendment filed on March 13, 2003, since the mid-1980s, conventional practice in the art has been to "partially stabilize" zirconia with at least 6-8 weight % yttria. Typical of that accepted teaching is U.S. Patent No. 4,485,151 to Stecura, cited in applicants' specification, which concludes that 6-8 weight % yttria stabilized zirconia should be used when the coating was applied using air plasma spraying. The Stecura '151 patent, like many other prior art references, also teaches against using lower threshold amounts of yttria because the zirconia is only "partially" stabilized, thereby providing an optimum mixture of cubic, tetragonal and monoclinic phases of coating material.

In the context of the May 12 Official Action, amended claims 9 through 13 are clearly patentable over the combination of Nissley et al '171 and U.S. No. 6,352,788 to Bruce et al. The '788 patent concerns the use of EBPVD to produce a strain-tolerant columnar grain structure, thereby enabling the substrate coating to expand and contract without causing damaging stress that might lead to spallation. The patent is completely silent about the use of dense vertically cracked deposition to form the substrate. Although the '788 patent does refer, at col. 3, line 62, to "other known processes," it does not specifically mention DVC, but instead cites only plasma spraying and low pressure plasma spraying. In addition, the '788 patent does not teach or suggest using DVC to improve particle erosion resistance.

Thus, persons skilled in the art simply would not be motivated to combine the teachings in Nissley et al '171 with the '788 patent (or any other prior art reference of

record) to achieve applicant's invention. Indeed, as noted above, the prior art uniformly teaches against using such low threshold amounts of yttria. Instead, the best resistance to thermal cycling using a DVC process requires that the coating contain at least 6% yttria-stabilized zirconia. *See, e.g.*, U.S. Patent No. 5,830,586 to Gray et al (recommending 8% yttria by weight and the balance zirconia, col. 2, line 2); No. 6,432,487 to Graham et al (requiring 6-8 wt % yttria with the balance zirconia, col. 2, lines 37-40; and No. 5,073,433 to Taylor (6 to 8% yttria with the balance zirconia, col. 4, lines 44-45). Persons skilled in the art also recognized that partially stabilized zirconia coatings with higher amounts of yttria – that is, above 6wt % up to about 9 wt% -- tend to avoid the monoclinic phase transformations that otherwise result in less favorable physical properties. *See, e.g.*, Thomas A. Taylor, "Testing of Stability and Thermal Properties of Thermal Barrier Coatings," 1994 ASM Handbook, Vol. 5 at p. 656.

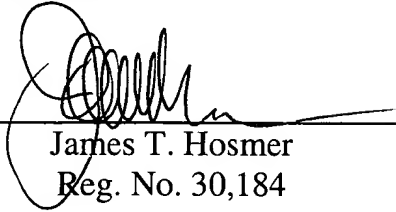
For all the foregoing reasons, applicants respectfully submit that the Examiner's rejections under 102 and 103 should be withdrawn and amended claims 9 through 13 be allowed.

SCHAEFFER et al  
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Respectfully submitted,

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